LABOR AND MATERIAL REQUIREMENTS IN THE PRODUCTION OF COMMERCIAL FIELD BEANS.

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The late war, with acompanying high prices for farm products, caused a large increase in the acreage of field beans in the United States resulting in competition between this crop and other cash crops grown in commercial bean regions. Because of the increasing economic importance of field beans and the demand for cost of production data, the Office of Farm Management and Farm Economics, United States Department of Agriculture, made a study of the labor. material and other requirements entering into the cost of production of this crop. Data were obtained in the spring of 1918, representing the experience of the men interviewed under conditions as they existed during the crop year 1917. One hundred sixty-six estimates were secured in seven of the leading bean producing States in areas which afforded typical conditions for the State or regions as a whole.

The regions chosen as representative were, for the humid area, Genesee County in New York, Tuscola County in Michigan and Columbia County, Wisconsin; for the Pacific Northwest, Latah County in Idaho; in the intermountain region for both dry and irrigated conditions, Weld County, Colorado; for dry land conditions, Mora County in Northeastern New Mexico and Torrance County in Central New Mexico; for Southern California, Ventura County; for the great interior valleys of California, Stanislaus County. In each of these counties field beans have for many years been one of the important crops and the farm practice is well established.

The discussion which follows is based on data obtained in these regions and is limited to the labor and material requirements in the production of this crop. These factors are of recognized value in making farm organization adjustments where the type of farming has remained fairly constant and in approximating costs for any given year, providing the farm practices in crop production have not changed materially.

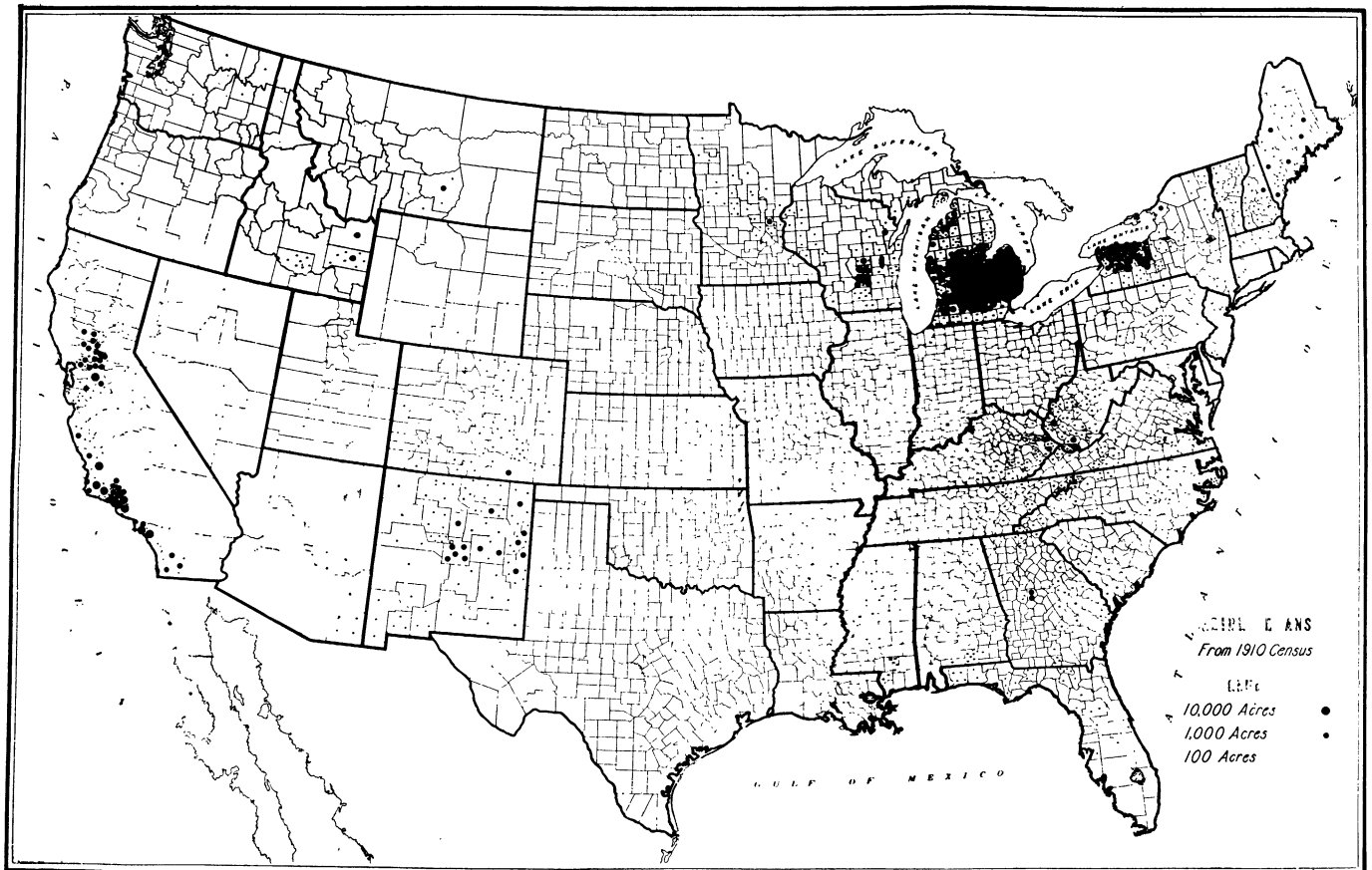

FIG. 1. Map of the United States showing areas where dry edible beans are grown commercially.

Geography of Production.—The geographic distribution of the bean acreage, as reported by the 13th Census is shown by the accompanying map, Fig. 1. Reference to this map shows that the principal regions where beans are grown commercially are Western New York and Central Michigan, the high altitudes of Colorado, Idaho and New Mexico and certain sections of California.

The bean plant grows well in most sections of the United States where there is a sufficiently long growing period free from frost to which it is very susceptible. The length of growing season required to mature a crop of field beans depends upon the variety and varies from 90 to 130 days.

Of all varieties the lima bean is the most sensitive to cold. It is not grown extensively as a field crop in any region of the United States except a narrow strip along the Pacific Coast in Southern California, of which Ventura County is the center of production. The almost constant high humidity caused by the heavy sea fogs which prevail here, makes this region especially well adapted to the production of lima beans.

While commercial beans are grown largely in the Northern States, it is probable that they could be grown successfully as a field crop in the Southern States. The main factors limiting bean acreage in the South seem to be the prevalence of fungus and insect enemies of this crop in the more southern localities.

Soils.—Field beans can be grown on a wide diversity of soil types, but thrive best on a warm, medium loam. Like other legumes they are partial to a limestone soil. Under humid conditions the land should be well drained, since water coming in contact with the bean for any length of time, especially in hot weather, is very injurious to the plant. Again, in the irrigated areas the bean plant is very sensitive to an alkali condition of the soil and does not thrive on alkali land where grain or sugar beets have failed. In all areas visited the field bean is produced mainly on the lighter soil types.

Bean Varieties and the Place Occupied by Beans in the Crop Rotation.—The leading commercial varieties in New York, Michigan and Wisconsin are the pea or navy type and the medium white. Of other varieties the red kidney is probably the most extensively grown. In each of the above mentioned States the bean occupies a place in the regular rotation of the farm crops. In New York they are commonly grown in a three year rotation of (1) clover, (2) beans

and (3) wheat. Where corn and potatoes enter into the rotation, these crops occupy a portion of the sod land and are usually followed by beans.

In Tuscola County, Michigan, sugar beets and field beans are important competing cash crops. It is a common practice to plant beans on sod land and follow with sugar beets. Where corn is grown, it is usually planted on sod land and sometimes followed by beans.

In Columbia County, Wisconsin, corn, which comes in direct competition with beans, is usually planted on sod land. Sometimes beans are grown on a portion of the sod land, but more often they follow corn in the rotation.

On irrigated land in Colorado, beans are usually grown in a rotation of (1) alfalfa 3 to 4 years, (2) potatoes one year, (3) beans one year, or sugar beets one year, followed by (4) small grain. Under Colorado and New Mexico dry land conditions there is no regular order of rotation of crops. The principal crops grown are beans, corn, cane and, to a lesser extent, oats, wheat and millet hay.

In Ventura County, California, up to the present time, there has been little rotation practiced on lima bean land. It is not uncommon for a grower to produce lima beans for from 4 to 10 years, on the same land. Sugar beets and barley, either for grain or hay, are the other crops grown in this region. In the upper San Joaquin Valley in Stanislaus County, California, it is a common practice to grow beans for 2 or 3 years on ground that has been in alfalfa 4 or 5 years, following with barley hay or grain and reseeding to alfalfa.

In Latah County, Idaho, winter wheat and beans are the main cash crops. Sufficient hay and other grains are grown to maintain the livestock kept on the farm. With few exceptions beans are followed by wheat in the crop rotation.

Marketing.—Beans direct from the thresher contain more or less dirt, discolored beans and other foreign matter. These beans are delivered to the local bean elevator or warehouse where they are run over a series of cleaning machines which remove much of the foreign matter. A sample is then taken and the tare or shrinkage determined. The clean marketable product remaining is usually sold to local bean dealers. Occasionally, however, the crop is handled through farmers' organizations, such as the California Bean Growers' Association and the Michigan Bean Growers' Association.

The California lima bean is a staple on the markets in all parts of the United States. The California pink, black-eye and other colored varieties are marketed principally in the southwest and southern

markets. The one exception to this rule is the red kidney, which is also grown extensively in eastern bean districts and finds a ready market in the east, especially in the New England States. The California small white, synonymous with the pea or navy variety grown in Michigan and New York, finds a ready outlet on all eastern markets.

The Colorado and New Mexico pinto bean has a standard market in the south and southwest.

New York, Michigan and Wisconsin navy and medium white beans are found on all eastern markets.

Bean Yields.—Since the yield per acre has such a decided influence on the cost per bushel or per hundredweight an attempt has been made to arrive at a fair yield to be expected in each of the States visited. In Table I the average yields for the State and farms visited in 1917 are recorded.

TABLE I.—*Annual yields.*

State and County.	Average for Farms Visited in 1917.	State Average.	1920 State Average.
N. Y.—Genesee county	10.9	9.3[1]	14
Mich.—Tuscola county	10.5	8.6[1]	13
Wis.—Columbia county	7.3	10.7[2]	10.6
Colo.—Weld county—non-irrigated	6.8		
Colo.—Weld county—irrigated	25	7.6[1]	8
N. Mex.—Mora & Torrance county	4.1	5.7[1]	6.7
Calif.—Ventura county—non-irrigated	26.5	10[1]	14.1
Calif.—Stanislaus county—irrigated	20.7		
Idaho—Latah county—non-irrigated	9.1	12[1]	10.2

For the past few seasons adverse weather conditions in New York, Michigan and Wisconsin have reduced bean yields. The spring of 1917 was especially cold and wet which delayed planting at the usual time, and was followed in the fall by an early frost which injured the crop. In addition to unseasonable weather conditions, fungus and insect enemies have been an important factor in reducing bean yields in these States.

On Colorado dry land the weather conditions in 1917 were not favorable to bean production. The late, cold spring, which delayed

[1] Monthly crop reporter, U. S. Department of Agriculture—6 year average.
[2] Wisconsin State Department of Agriculture Bulletin No. 28—5 year average.

planting, followed by a long dry period, reduced the yield to an average of about 200 lbs. per acre. An average yield for the dry land areas of Weld county is probably about 6 bushels per acre.

Dry years do not affect to so great an extent the yield of beans under irrigation. On Colorado irrigated land growers may expect yields of from 20 to 25 bushels per acre. The State average does not show the yield for dry and irrigated land separately. Since only about 20 percent of the Colorado beans are grown under irrigated conditions, the six year State average of 7.6 bushels reflects the yield on dry land rather than on irrigated land.

New Mexico beans are grown principally under dry land conditions and with a very limited rainfall. However, both in New Mexico and Colorado this rainfall occurs mainly during June, July and August after the crop has been planted. In New Mexico it is possible to mature a crop averaging about six bushels per acre. In 1917, which was an exceedingly dry year, it will be noted that the average yield was only 4 bushels per acre.

In the lima bean areas of Ventura County, California, slightly different conditions exist; the average rainfall, which amounts to only about 15 inches, occurs mainly during the months of December, January, February and March before the crop is planted. The relatively high humidity and cool temperature make it possible to produce from 18 to 25 bushels per acre without irrigation.

Atmospheric conditions of the San Joaquin Valley, of which Stanislaus County is fairly representative, are exactly opposite. Here the relative humidity is low and the temperature high, making irrigation necessary. An average yield of 20 bushels may be expected here on land that is single cropped, while on double cropped land, that is, where two crops are grown on the same land within the year, an average yield of 10 bushels per acre may be expected. The State average of 14.1 bushels includes both irrigated and dry land beans, and therefore is not representative for any given condition.

The upland bean regions of northern Idaho where the temperature is moderate have sufficient rainfall to mature field crops without irrigation. The rainfall in 1917 was considerably below normal, which reduced the average yield for that year. Like California, the State average yield includes beans grown with and without irrigation.

Requirements of Production.—The quantitative acre requirements of field bean production are discussed under the following headings:

(*a*) Man and horse labor.
(*b*) Manure.
(*c*) Fertilizer.
(*d*) Seed.
(*e*) Threshing fuel.

Man and Horse Labor.—The requirements as shown in Table II consist of all the man and horse labor expended by the farmer in the production of this particular crop.

TABLE II.—*Labor requirements.*

State and County.	Hours of Labor Per Acre.									
	Preparing Seed Bed.		Cleaning Seed and Planting.		Cultivating and Irrigating.		Harvesting and Marketing.		Total.	
	Man.	Horse	Man.	Horse	Man.	Horse	Man.	Horse	Man.	Horse
Humid areas:										
N. Y.—Genesee Co...	13.1	36.2	1.1	1.9	13.4	15.2	14.3	8.2	41.9	61.5
Mich.—Tuscola Co...	12.7	31.3	1.3	2.6	13.0	9.0	12.4	7.1	39.4	50.0
Wisc.—Columbia Co..	8.4	24.7	.9	1.7	10.9	9.8	12.1	8.7	32.8	44.9
Average.....	11.8	31.7	1.1	2.1	12.7	11.7	13.1	7.9	38.7	53.4
Semi arid areas:										
Calif.—Stanislaus Co. irrigated.....	9.8	31.7	1.3	2.3	8.9	3.9	17.5	11.3	37.5	49.2
Colo.—Weld Co., irrigated.....	11.2	35.6	1.1	2.2	15.6	17.7	18.4	12.0	46.3	67.5
Average.....	10.5	33.7	1.2	2.2	12.4	11.0	17.9	11.7	42.0	58.6
Colo.—Weld Co., non-irrigated.....	4.9	16.6	1.6	3.2	8.8	11.6	10.5	9.1	25.8	39.5
N. Mex.—Mora and Torrance Cos., non-irrigated....	4.5	18.5	1.3	3.4	11.5	11.7	10.8	6.3	28.1	39.9
Average.....	4.7	17.7	1.4	3.3	10.3	11.6	10.7	7.1	27.1	39.7
Calif.—Ventura Co., non-irrigated....	9.0	62.8	1.1	1.7	14.9	6.8	9.0	6.7	34.0	78.0
Idaho—Latah Co., non-irrigated....	6.2	30.2	1.2	1.8	13.9	10.0	8.9	7.0	30.2	49.0
Average.....	7.6	46.5	1.2	1.8	14.4	8.4	9.0	6.8	32.3	63.5

In all sections, except Ventura County, California, the farmer with the assistance of his hired help performed all the labor involved. In this county, however, threshing was done at a contract rate per

hundredweight, and it was therefore impossible to report the hours of labor required for this work.

In the humid bean areas of New York, Michigan and Wisconsin, the operations entering into the production of this crop are very similar. The one great difference is in the method of harvesting. In Wisconsin the threshing is from the stack in the field, while in New York and Michigan it is done from the barn. Of these three States the labor required for seed bed preparation was lowest in Wisconsin. In the latter State the light soil type was the main factor influencing the labor required. In New York and Michigan the land was covered an average of 3.7 times and 2.9 times respectively with the spring-tooth harrow which was the chief implement used. In Wisconsin the lighter spike-tooth harrow was used almost exclusively. An average day's work with the spring-tooth harrow was about 10 acres, with the spike-tooth 22 acres. Again in Michigan the land was rolled an average of 1.6 times and in New York 2.1 times, while in Wisconsin no rolling was necessary. In all three of the above States beans were planted with an ordinary grain drill at the rate of about 11 acres per day.

Labor requirements in irrigated areas of Stanislaus county, California, were considerably less than in Weld county, Colorado. It will be seen from Table II that more time was expended in cultivating and irrigating in Weld county than in Stanislaus county. In the former area the crop was cultivated an average of 2.7 times and irrigated approximately 3 times. In the latter area it was cultivated an average of 1.6 times and irrigated once. In both areas spring- and spike-tooth harrows were the principal tools used in preparing the seed bed. Planting was done at the rate of about 10 acres per day with the two-row planter.

In the non-irrigated areas of Colorado and New Mexico the labor required in producing field beans showed little variation, which is to be expected, since the factors influencing the labor requirements are very similar. The disk and spike-tooth harrow were the implements chiefly used in preparing the seed bed. Disking was done at the rate of about 10 acres per day and harrowing with the spike-tooth harrow at the rate of about 15 acres per day. Planting was done either with the two-row bean planter or one-row lister. The threshing was all done from stacks in the field. The labor required for harvesting and marketing constituted about 39 percent of the man labor and 18 percent of the horse labor required in producing the crop.

Considering all the regions visited, labor requirements were highest in the lima bean areas of Ventura County, California. The majority of this labor was expended in the preparation of a suitable seed bed. Harrowing with the spike-tooth and spring-tooth harrow and chiseling and disking are labor operations common to this area. Much of this work is expended in an attempt to eradicate the morning glory, a serious weed pest in this region. An average day's work with the disk is 12 acres, with the chisel 10 acres, with the spike-tooth 24 acres and with the spring-tooth 13 acres.

In northern Idaho the implement most commonly used in preparing the seed bed were the spike- and spring-tooth harrows. The crop was cultivated an average of 3.3 times in Ventura and 2.6 times in northern Idaho. It was hoed 2.6 times in Ventura and 1.5 times in northern Idaho.

Manure.—No manure was applied to the bean crop in the dry land areas of New Mexico, Colorado, California or Idaho. In these areas the supply of manure is not large. In addition the rainfall is limited and manures do not decompose and become available as plant food so rapidly as in the more humid areas. Twenty-six percent of the total bean land represented in New York, 22 percent in Wisconsin, 12 percent and 4 percent respectively in the irrigated areas of Colorado and California received benefit from an application of manure. In estimating the benefit of the manure to the bean crop it is assumed that during the first year 50 percent is consumed and 30 and 20 percent respectively during the next two years.

TABLE III.—*Manure requirements.*

State and County.	Percent of Farmers Applying Manure.	Average Amount Applied, Tons.	Average Amount Chargeable to Beans, Tons.[3]
N. Y.—Genesee Co.	93	12.51	3.57
Mich.—Tuscola Co.	43	13.55	1.33
Wisc.—Columbia Co.	81	16.46	3.42
Colo.—Weld Co., irrigated	56	21.77	2.96
Calif.—Stanislaus Co., irrigated	27	8.9	.42

The average amount of manure applied represents the quantity used on the acreage actually manured. To determine the average amount chargeable to the entire bean acreage the total application was prorated over the entire acreage as shown in column 3 of this table.

[3] Prorated over entire bean acreage.

Commercial Fertilizer.—New York, Michigan and Wisconsin were the only regions visited where commercial fertilizer was applied to bean land. Farmers in the more western bean areas where the soils are relatively high in mineral nutrients but rather low in humus content, have not found it necessary to apply commercial fertilizer in order to maintain their crop yields. Forty-eight percent of the total bean acreage of New York, 13 percent in Michigan and only 4 percent in Wisconsin received an application of commercial fertilizer.

TABLE IV.—*Commercial fertilizer requirements.*

State and County.	Percent of Farmers Applying Fertilizer.	Average Amount Applied, Pounds.	Average Amount Chargeable to Beans, Pounds.[4]
New York—Genesee Co.	57	181	95
Michigan—Tuscola Co.	18	117	30
Wisconsin—Columbia Co.	12	275	7

The average application of fertilizer represents the amount used on the acreage fertilized. The amount chargeable to the entire bean acreage was determined in the same way as has been explained for manure.

Seed.—Table V shows, for each of the regions visited, the varieties grown and the average amount of seed, in pounds, applied per acre. The principal factors regulating the seed requirements are the number of seeds in a pound, the width of row and the amount of moisture available.

Under eastern conditions, with 28 inch rows, the amount per acre for the small navy is about 45 pounds, for the medium white variety 60 pounds. In the dry land pinto bean sections of New Mexico and Colorado, where the moisture is limited, the amount is about 15 pounds. However, in the irrigated pinto bean sections of Colorado, where more moisture is available, about 30 pounds per acre are used. In the lima bean areas of California more seed is planted than was formerly necessary, because of the ravages of the bean wire worm at planting time. In Idaho, where the width of row ranges from 36 to 40 inches, the amount of seed recommended for the small navy variety is about 25 pounds, for the large navy about 30 pounds per acre.

[4] Prorated over entire bean acreage.

TABLE V.—*Seed requirements.*

State and County.	Variety.	Percent of Farmers Growing This Variety.	Pounds Per Acre.
N. Y.—Genesee Co.	Navy	64	50
	Medium White	36	61
	Red Kidney	7	82
Mich.—Tuscola Co.	Navy	100	46
Wis.—Columbia Co.	Navy	100	66
	Black Valentine	19	80
Colo.—Weld Co., irrigated	Pinto	100	30
Colo.—Weld Co., non-irrigated	Pinto	100	15
N. Mex.—Mora & Torrance Co., non-irrigated	Pinto	100	17
Calif.—Ventura Co., non-irrigated	Lima	100	81
Calif.—Stanislaus Co., irrigated	Lady Washington	13	15
	Red Kidney	20	26
	Red Mexican	27	18
	Pinks	27	18
	Black Eye	73	17
	Tepary	20	12
	Blue Pods	7	9
Idaho—Latah Co., non-irrigated	Small Navy	73	23
	Large Navy	13	27
	Lady Washington	27	26
	Pinks	7	20

Threshing Fuel.—In the bean-growing regions of Mora and Torrence Counties, New Mexico and in the irrigated sections of Stanislaus County, California, no threshing fuel was furnished by the farmer. Gasoline tractors usually furnish the power to run the bean separator. The gasoline is furnished with the thresher, so that the threshing rate in these regions includes the fuel. In the lima bean section of Ventura County, California, the bean straw is used for threshing fuel. Because of the small quantity required, no attempt was made to estimate the value of the straw consumed. Cord wood, the chief threshing fuel in Latah County, Idaho, was used at the rate of .027 cord per acre. The threshing coal requirements per acre for New York, Michigan, and Wisconsin were respectively 62, 86 and 64 pounds; for Colorado irrigated 124 pounds, and for Colorado non-irrigated land 56 pounds per acre.

Bean Sacks.—Expense to the farmer for sacks furnished in marketing the crop showed considerable variation for the several areas visited. In New York, Michigan, and Wisconsin, the crop is hauled to the local warehouse or elevator in ordinary grain sacks, which are emptied and returned to the farm.

In Colorado and New Mexico, pinto beans are bagged in uniform 100 pound sacks. However, in Colorado the farmer does not furnish the sack.

In California, beans are shipped in standard 100-pound sacks with the exception of the black-eye variety, which is marketed in 90-pound sacks. Since the requirements of production in Stanislaus County are based on the yield of black-eye beans, the sack requirements for this variety are shown in the table. In Idaho the crop is hauled to the local warehouse in grain sacks of from 135 to 150 pounds, capacity, which are not returned to the farmer.

TABLE VI.—*Bean sack requirements.*

State and County.	Yield per Acre, Pounds.	Size of Sacks, Pounds.	Sacks per Acre.
N. Mex.—Mora and Torrance Co., non-irrigated	246	100	2.5
Calif.—Ventura Co., non-irrigated	1590	100	13.9
Calif.—Stanislaus Co., irrigated	1243	90	13.8
Idaho—Latah Co., non-irrigated	548	148	3.7

LABOR AND MATERIAL SUMMARY.

In Table VII are summarized the labor and material requirements of bean production which have been discussed in the preceding pages of this article. As has been stated, the methods of handling the bean crop show some variation even within the same region. Throughout this article the requirements represent the prevailing methods in each region visited. For instance, the amount of seed used per acre in New York, Michigan, and Wisconsin represents the amount recommended for the small navy variety; in Colorado and New Mexico the pinto bean; in California, irrigated, the black eye; in California, non-irrigated, the lima; and in Idaho, the small navy.

Again in New York and Michigan, the harvest labor represents the amount required when the crop was threshed from the barn; in Colorado, Wisconsin and Idaho from the stack; in the irrigated portions of California from the field; and in the non-irrigated lima bean sections of California by outside contract labor.

The value of these requirements, which may be expressed in quantities, constitute about 75 percent of the total operating expense, *i.e.*, the total cost less land rent.

TABLE VII.—*Summary of average labor and material requirements per acre.*

Items.	New York, Genesee Co.	Michigan, Tuscola Co.	Wisconsin, Columbia Co.	California (Irrigated), Stanislaus Co.	Colorado (Irrigated), Weld Co.	Colorado (Non-irrigated), Weld Co.	New Mexico (Non-irrigated), Mora and Torrence Cos.	California (Non-irrigated), Ventura Co.	Idaho (Non-irrigated), Latah Co.
Yield	10.9	5	7.3	20.7	25	6.8	4.1	26.5	9.1
Man hours	41.9	39.4	32.3	37.5	46.3	25.8	28.1	34.0	30.2
Horse hours	61.5	50.0	44.9	49.2	67.5	39.5	39.9	78.0	49.0
Manure—Tons	3.57	1.33	3.42	.42	2.96	.....	.....	.....	.....
Fertilizer—Pounds	95	30	7	.....	.....	.....	.....	.....	.....
Seed—Pounds	50	46	66	17	30	15	17	81	23
Threshing fuel	62[5]	86[5]	64[5]	.....	124[5]	56[5]	.....	.....	.027[6]
Sacks—Number	.....	.....	.....	13.8	.....	.....	2.5	15.9	3.7
Percent of operating expense	77	73	74	62	68	72	82	60	79

Table VIII shows how prices and yields may be applied to requirements of labor and materials in estimating the cost of bean production. Genesee County, New York, has been taken as an example.

Twenty-six percent of the entire bean acreage was manured and forty-five percent received an application of commercial fertilizer. Therefore to determine the average amount chargeable per acre the total application was distributed over the entire bean acreage. (See Tables III and IV.) Labor and materials constitute seventy-seven percent, and other costs, which include threshing, use of machinery, taxes and insurance, overhead and handling charges make up the other twenty-three percent of the operating expense.

As long as the ratio of the total cost of these quantitative requirements to the total operating expense remains fairly constant and constitutes so large a percent of the total operating expense they serve as valuable basic data for approximating costs.

[5] Pounds of coal.

[6] Cords of wood.

TABLE VIII.—*Estimated cost of producing field beans, Genesee Co., N. Y. —1920.*

Items.	Percent of 1917 Operating Expense.	Amount.	Estimated Rate.	Cost per Acre.
Man hours	26	41.9	$ .35	$14.66
Horse hours	27	61.5	.24	14.76
Manure—tons	13	3.57	2.00	7.14
Fertilizer—pounds	2	95	30	1.42
Seed—pounds	8	50	.085	4.25
Threshing fuel—pounds	1	62	12.00	.37
Total labor and material expense	77			$42.60
Total operating expense	100[7]			55.32
Use of land		$110	6%	6.60
Total cost				$61.92
Credit bean straw		.42 T	$10	4.20
Total net cost per acre				$57.72
Total net cost per bushel, 16.5 bus. yield				$ 3.50

[7] $42.60 ÷ 77 × 100 = $55.32 or total operating expense.

REVIEW OF FARMERS' BULLETIN NO. 1093 "INFLUENCE OF THE TRACTOR ON USE OF HORSES."

Farmers' Bulletin 1093 by L. A. Reynoldson, is a study of the influence of the tractor on the use of horses on 191 Corn Belt farms. The results of the study show that the tractors displaced an average of 2½ horses per farm and increased the number of crop acres per per horse from 26½ to 38½. The tractor accomplished approximately 25 percent of the tractive work. But 16 operators of the 191 allowed the horses to stand idle when the tractor was in use. The minimum number of horses necessary was governed by the cultivations of the corn crop. The average number of days the tractor was used was 29 ten-hour days. The purchase of the tractor also had a slight effect on the size of the farm which was increased by 22 acres. The main advantage of the tractors is their ability to do heavy work in a shorter time than is possible with horses.

The publication does not include the effect of the tractor on the horses themselves, whether the quality was lowered, or whether it cost as much to keep horses when a tractor was maintained for the heavier labor. The study was well presented.

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